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We're So Accustomed to Using Chlorine That We Tend to Overlook Its Toxicity

CHLORINE IS a poisonous gas. Its chemical reactivity is so high that it cannot long persist in nature, being rapidly converted to the innocuous chloride ion, the form in which it is most abundantly found as, for example, in common salt. It is an extremely important industrial chemical playing an indispensable role in the production of plastics, drugs, pigments and many other organic materials.

In the form of sodium hypocholrite, domestic bleach solution, it is a well-known household article. It also plays an indispensable role in the purification of our water supplies. We are so accustomed to meeting it in our environment that we hardly notice it except when someone has zealously overdosed his swimming pool.

The chlorination of water supplies in the United States began just 60 years ago in Jersey City. Its use spread very rapidly and today it is undoubtedly the major bulwark against typhoid fever, dysentery and cholera. It would be conservative to say that it has saved, millions of lives. In fact, concentrated urban settlement would be impractical without chlorination or some equivalent means of removing polluting bacteria from water.

CHLORINE HAS been used for the treatment of sewage since 1835, long before Pasteur and Koch showed that infectious disease was an attack upon the human body by living microbes. The rationale was the dissipation of foul orders, which were long blamed for contagion.

Chlorine was first introduced in the waterworks of Jersey City in response to potential contamination by sewage from some small towns above it. The city demanded that the water company install expensive filtration equipment or pay for diversion of the sewage. After considerable litigation, the court found that chlorination was both safe and effective for the production of potable water.

It is difficult to reconstruct the arguments that would support the safety of chlorination by contemporary standards. A few tests of acute toxicity did show that chlorinated water could be administered in concentrations to 50 to 100 parts per million, compared with the 1 to 2 PPM generally required for water purification. Furthermore, during World War I, chlorine, under the name of Dakin's solution, was the only available disinfectant for contaminated wounds, and it did a heroic job by the standards of the day.

THIS ARTICLE is not a scare story about a newly discovered hazard of an ingredient to which most of us have been constantly exposed to since birth. It is, rather, a reminder that almost no attention has been given to the subject of chronic toxicity from chlorine.

Perhaps we sense such a dependence on the chlorine disinfection of water that we prefer not to be embarrassed by information about relatively minor side effects. This view is not, however, likely to be defended as a rational basis for social policy.

The only serious contribution to the subject that I could find was from a German scientist, Dr. H. Druckrey of the Max Planck Institute for Immumobiology at Freiburg. He reared a group of laboratory rats for seven generations on drinking water supplemented with 100 PPM of chlorine. The treated animals showed no obvious pathology or shortening of the life span compared to the controls. This is an impressive demonstration that should have been made at least 50 years earlier.

Many theoretical suspicions nevertheless remain. One argument for chlorine is its rapid removal by reaction with organic material in body fluids. These reactions have, however, not been studied with modern methods. We have no clear picture of the place, manner, intermediate products or rate by which chlorine is converted into chloride ion within the body. These experiments would not be very difficult to carry but with the help of radioactive tracers.

WHAT LITTLE we do know of the chemistry of chlorine reactions is portentous. It should sometimes react with nitrogenous groups from various sources to form substances that may eventually reach and react with the genetic material, DNA, of body cells. This is only a speculation so far. In any case, it would probably be applicable only to heavily contaminated waters needing heavy doses of chlorine.

The reactions of chlorine with DNA have been remarkably little studied. In my own search in the literature, I found only a single oblique reference. Chlorine, casually compared with iodine, rapidly inactivated DNA that had been isolated from bacteria.

We know little more of the mechanism by which chlorine kills bacteria. The scanty data suggest that the most likely mechanism is precisely by attack on the DNA of the microbe.

That chlorine is also intended to inactivate viruses should provoke questions about the production of mutations in view of the close chemical similarity between viruses and genes. Many geneticists have raised cautions about chemicals that may cause mutations, and I will join them by adding chlorine to the lengthy list that cry out for close scrutiny.

Science is under broad attack today for creating an unmanageable technology that swamps human individuality, fouls the environment and imperials the surival of the species. More often than not, however, science may be blamed for carrying the bad news that we know to little rather than too much to support the growing numbers of peoole who proliferate themselves and their wastes over the planet.